Temperature Sensor with Single-wire Digital Interface

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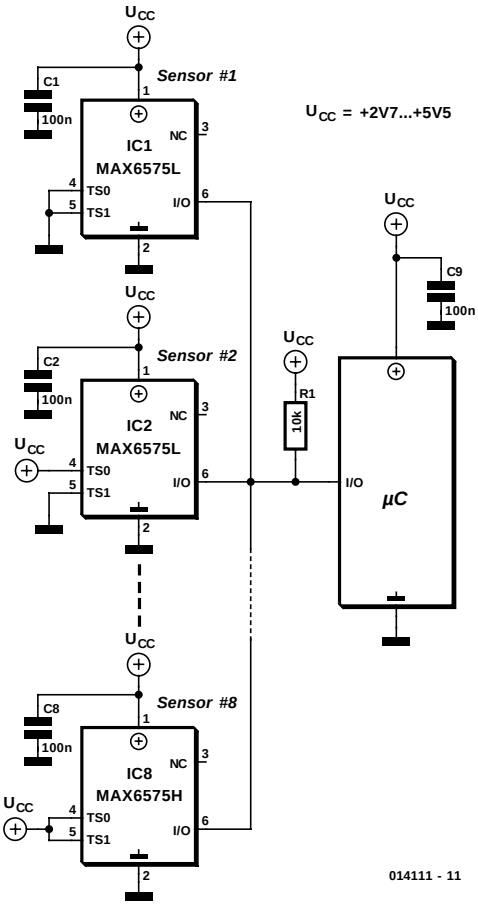

A temperature measurement system with up to eight distributed temperature sensors can be realised using only a single signalling lead. This objective is supported by the Maxim MAX6575 temperature sensor (www.maxim-ic.com), which can be used to measure temperatures between –40 °C und +125 °C. It is housed in a small SMD transistor package (SOT23). As shown in **Figure 1**, all the ICs are connected to the signalling line via their open-drain input/output pins. Resistor R1 pulls the voltage on the signalling line to Vcc. The microcontroller can initiate a measurement cycle by placing a Low pulse on the signalling line for an interval of 2.5 µs to 1 ms. The MAX6575 ICs recognise this pulse, and each one starts a timer whose period is proportional to the temperature T*n* of sensor *n* (in degrees Kelvin). One of four different timer coefficients can be selected for each MAX6575 using the TS0 and TS1 inputs. The timing is illustrated in **Figure 2**.

In order to allow eight different sensor positions to be used, the MAX6575 comes in two versions: the H version and the L version. The table shows the configurable timer coefficients in microseconds per Kelvin for the two versions. As

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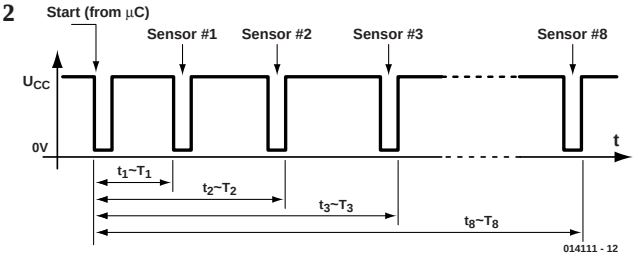

can be seen, overlaps in the pulse durations can occur in case of large differences between the temperatures of the individual sensors (e.g. sensor *n* at +125 °C, sensor *n*+1 at –40 °C). To the extent that such an unlikely situation can arise, it may be necessary to omit one of the timer regions, which would mean that the maximum number of sensors connected to a single line would be reduced to seven or six.

The temperature of sensor *n* in Kelvin is given by

$$Tn = tn / Mn$$

where
T*n* = temperature of sensor *n* in Kelvin;
t*n* = time between the Start pulse and the pulse from sensor *n*:
M*n* = temperature factor of sensor *n* in µs/K

The temperature can be converted to degrees Celsius using the formula

$$Tn\ (\text{in °C}) = Tn\ (\text{in K}) - 273.15\ \text{K}$$

A new measurement requires the microcontroller to first generate a Reset pulse, which is a Low pulse with a duration of at least 4.6 ms so that it can be reliably distinguished from the Start pulse. The maximum allowable length of the Reset pulse is 16 ms. The MAX6575 also allows a new measurement to be made without a Reset pulse if the elapsed time since the previous Start pulse is more than 520 ms.

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TS1	TS0	MAX6575L	t*n* for –40°C to +125°C
GND	GND	5 µs/K	1.16 ms to 2.0 ms
GND	VDD	20 µs/K	4.66 ms to 8.0 ms
VDD	GND	40 µs/K	9.32 ms to 16.0 ms
VDD	VDD	80 µs/K	18.64 ms to 32 ms
TS1	**TS0**	**MAX6575H**	**t*n* for –40°C to +125°C**
GND	GND	160 µs/K	37.28 ms to 64 ms
GND	VDD	320 µs/K	74.56 ms to 128 ms
VDD	GND	480 µs/K	111.84 ms to 192 ms
VDD	VDD	640 µs/K	149.12 ms to 256 ms